Cryptosporidiosis epidemiology in NSW

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Health Protection NSW
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Summary

- Natural history
- Epidemiology
- Case studies
### Waterborne cryptosporidiosis since 2000

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Type</th>
<th>Health effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Battleford, SK Canada</td>
<td>2001</td>
<td>Cryptosporidium</td>
<td>5,800-7,100 cases</td>
</tr>
<tr>
<td>Galway, Ireland</td>
<td>2007</td>
<td>Cryptosporidium</td>
<td>242 lab confirm</td>
</tr>
<tr>
<td>Northampton, England</td>
<td>2008</td>
<td>Cryptosporidium</td>
<td>422 cases</td>
</tr>
<tr>
<td>Östersund, Sweden</td>
<td>2010</td>
<td>Cryptosporidium</td>
<td>27,000 cases</td>
</tr>
<tr>
<td>Skellefteå, Sweden</td>
<td>2011</td>
<td>Cryptosporidium</td>
<td>~20,000 cases</td>
</tr>
</tbody>
</table>

### Costs of gastrointestinal illness

- Estimate of $303.40/person/year for gastro cases prevented
- Milwaukee outbreak ~US$96.2 million
- Walkerton outbreak ~Can$65 million
Introducing *Cryptosporidium*

- A genus of protozoan organisms that are mostly parasites of digestive tracts of a range of animals
- Two species commonly cause illness in humans: *C. hominis* and *C. parvum*
- The other main reservoir of *C. parvum* is cattle, particularly calves
- Catchment areas containing human habitations and/or cattle have the potential to release *Cryptosporidium* to waterways
Introducing *Cryptosporidium*

- *Cryptosporidium* is released in faeces
- Disseminated and survives in the environment as double walled oocysts (4-6 µm) that can survive for long periods and resist chlorine disinfection
- Needs careful filtration to remove from water
- Each oocyst contains 4 sporozoites. Once ingested these colonise the small intestine, beginning a complex life cycle
- *Cryptosporidium* causes illness by affecting epithelial cells of gastrointestinal, biliary and respiratory tracts
Pathology

- Incubation period can range from 1-12 days
- Major symptom is diarrhoea, often profuse and watery, with abdominal cramping
- In children the diarrhoea may be preceded by loss of appetite and vomiting
- Symptoms can continue for up to 30 days
- Excretion of oocysts continues for several weeks after symptoms resolve
Immunity and resistance

- Immunocompetent people may have asymptomatic or self-limited symptomatic infections
- Asymptomatic infection can be a source of infection for others
- Clinical course of illness can vary in immunosuppressed individuals, for some very serious and potentially fatal
Table 3. Rate of Infection, Enteric Symptoms, and Clinical Cryptosporidiosis, According to the Intended Dose of Oocysts.*

<table>
<thead>
<tr>
<th>INTENDED DOSE OF OOCYSTS</th>
<th>NO. OF SUBJECTS</th>
<th>INFECTION</th>
<th>ENTERIC SYMPTOMS</th>
<th>CRYPTOSPORIDIOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>number (percent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>5</td>
<td>1 (20)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>8</td>
<td>3 (37.5)</td>
<td>3 (37.5)</td>
<td>3 (37.5)</td>
</tr>
<tr>
<td>300</td>
<td>3</td>
<td>2 (66.7)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>500</td>
<td>6</td>
<td>5 (83.3)</td>
<td>3 (50)</td>
<td>2 (33.3)</td>
</tr>
<tr>
<td>&gt;=1000†</td>
<td>7</td>
<td>7 (100)</td>
<td>5 (71.4)</td>
<td>2 (28.6)</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>18</td>
<td>11</td>
<td>7</td>
</tr>
</tbody>
</table>
Pathways to infection

- Faecal oral route
- Public swimming pools
- Childcare centres
- Zoonotic infection (from animals)
- Person to person eg transmission within families
- Waterborne
- Foodborne
5-year average of NSW cryptosporidiosis notifications from 2010-2014 by gender and age group
Notifications of cryptosporidiosis, NSW, 1997-YTD2015

Increase across NSW, swimming pools

Increase in south eastern Sydney, pools and person-to-person

Increase across NSW, swimming pools

Increase across NSW, swimming pools

Increase across NSW, swimming pools

Increase across NSW, swimming pools

Number of notifications

Year and month
Notification rates of cryptosporidiosis, NSW & Australia, 2009-YTD 2015
How effective is surveillance?

(Frost et al., 1996)
Sporadic cases

Case control study in Adelaide and Melbourne found that the highest risk for sporadic cases came from:
- public swimming pools
- person to person transmission
- overseas travel with consumption of unboiled water, salads etc
- compromised immune system
- Public drinking water **not** a risk factor

Robertson, B et al, Case control studies of sporadic cryptosporidiasis in Melbourne and Adelaide, Australia, Epidemiol. Infectt: 2002, 128, 419-431
Zoonotic transmission

- Study of farm workers and cattle in the Hunter-New England region of NSW found consistent strains of Cryptosporidium in cattle and the farm workers who handled them. (Ng JSY et al, Evidence of Cryptosporidium transmission between cattle and humans in northern NSW, Experimental Parasitology: 2012)

- Another study of cattle strains and strains from sporadic cases in the general community found a similar correlation between strains of Cryptosporidium in cattle and humans (Waldron LS, et al, Sporadic human cryptosporidiosis, Australia: molecular epidemiology, spatio-temporal analysis and ecology, Applied Environmental Microbiology: 2011)

- Cryptosporidium with the ability to cause human disease is present in cattle in NSW
The 1998 Sydney outbreak incident

SYDNEY’S WATER CRISIS

3 MILLION NOW HIT

Entire city told to boil water

THE CULPRIT

Gyrotrichiasis

No need for panic, say doctors

Bladder cancer may be linked to chlorine
Outbreak case study - Jackson County, Oregon, 1992

- Cryptosporidium outbreak in Ashland

- Epidemiological study identified that illness linked to drinking water from the nearby town of Talent

- While Ashland residents got sick from drinking Talent water, Talent residents did not

- Raw water for Talent supply drawn from creek 7.5 km downstream from Ashland STP.

- Filters only achieving finished turbidities of 0.5 – 2.0 NTU

- People in Talent possibly resistant or immune to Cryptosporidium
Outbreak case study - Milwaukee

- Estimated 403,000 people had watery diarrhoea attributable to outbreak

- 4400 hospitalised and premature deaths of at least 69 immunocompromised persons (mainly HIV positive)

- Increased flows in rivers supplying Lake Michigan could have carried oocysts from human or animal effluent

- Filters at one plant failed to maintain good operation
Outbreak case study – Östersund, 2010

- Östersund a city of 53,000 beside a large lake
- Main water supply drawn from the lake and treated through pH adjustment, ozonation, filtration and chlorination
- Large gastro outbreak (~20% of town) identified, with many laboratory cases identified as cryptosporidiosis
- The likely index cases were a single household with a failed on site sewage disposal system.
- Effluent from this onsite system was leaking into a stormwater drain, leading to the lake
Boil water alerts

- In NSW we try not to wait for illness as the signal for a boil water alert.

Figure 4.51 Date of onset of diarrhea cases – Anderson Township (Source: Angulo et al., 1997, by permission Copyright ©1997 American Public Health Association)
Conclusions/knowledge gaps

- Science tells us the risk factors for the presence of Cryptosporidium in water catchments
- Science also tells us how to protect water through catchment measures or treatment (Australian Drinking Water Guidelines)
- Good surveillance may not find endemic disease
- Nor does it predict or protect us from outbreaks
- Protecting drinking water from Cryptosporidium has other benefits